Space Weather Technical Forecast

Issued on Friday, 12 January 2024 at 01:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing likelihood of isolated M-class flares, with a slight chance of X-class flares

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with three M-class flares. The largest an M1.5 at 11/2328 UTC from AR3539.
There are currently eleven sunspot regions on the visible disc, of which seven are numbered, with AR3538 now behind the west limb but still the region generated one of the M-class flares of the past 24 hours. AR3539 has been the most active region on the disc, but is not magnetically complex or the largest region on the disc. Currently AR3539 is classified as Dai/beta. Other moderate size groups, 3540/3541/3545 have all shown little overall change, as have the remaining regions on the disc which are small, weak and magnetically simple.

A filament eruption was observed in the northeast, beginning around 11/0500UTC, with an associated CME. This has been analysed as missing Earth. A CME was observed in the southwest, associated with a M1.2 flare from AR3539 peaking at 11/1923. This will also be assessed once updated coronagraph imagery becomes available, but is considered unlikely to be Earth directed.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR and ACE at L1, were predominantly at slightly elevated speeds, on average around 450 km/s. Density was most likely below average throughout, with the switches between the different satellites making readings erratic, as also with the solar wind speed. Interplanetary magnetic field (IMF), Bt, was weak, 4-8nT The north-south component, Bz, weakly fluctuated between positive and negative, reaching a maximum negative value of -5nT. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux declined to background levels. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was well below Active throughout. The 12/0000 UTC observation was 1.71e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate solar activity is likely to continue with further isolated M-class flares, and a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: There is a potential glancing CME arrival. This left the Sun on 09 Jan due to a filament eruption in the southeast disc, and gives a chance of a very slight glance tomorrow (13 Jan). Otherwise, slow wind conditions are expected to persist with background to slightly elevated wind speeds. Quiet (Kp 0-2) geomagnetic conditions are expected for much of the period, but may rise to give a spell of Unsettled (Kp 3) with a chance of Active with any glancing CME.

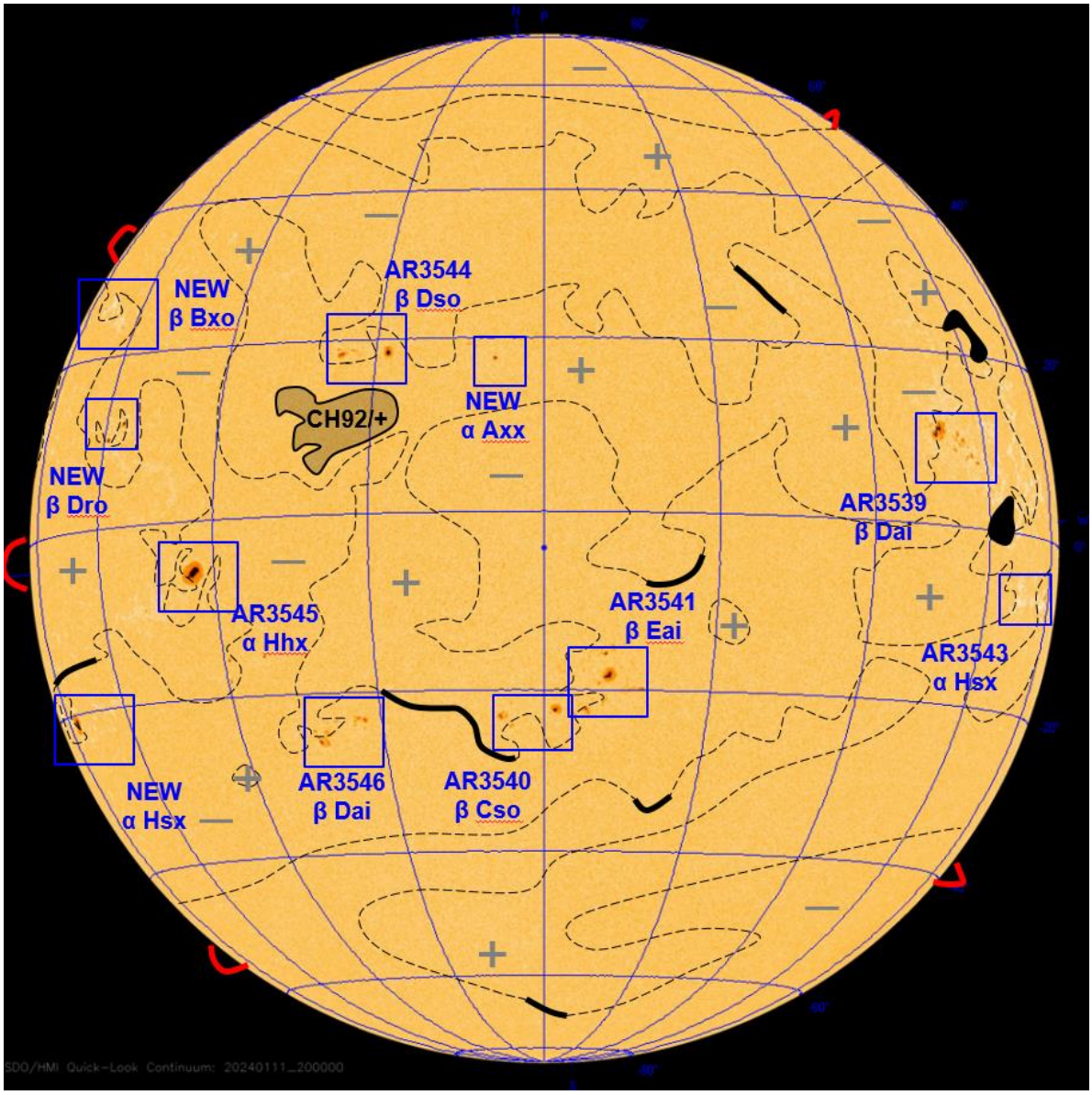
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: High energy proton flux is forecast to remain at background through the period, but with a slight chance of seeing increases towards the S1 minor radiation storm threshold given any notable flaring. The high energy electron flux is forecast to persist at background, with the associated 24 hour electron fluence remaining below the Active (1e8) threshold.

Figure 1. Solar Analysis Valid 11/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

A glancing CME arrival is possible tomorrow (13 Jan), originating from a complex filament lift-off from the southeast disk on 09 Jan.

Solar wind speeds are slightly elevated and expected to persist at this or background levels throughout. This is supported by MOSWOC Enlil.

Mainly Quiet (Kp 0-2) geomagnetic activity is expected to persist, with only a slight chance of isolated Unsettled intervals. Any CME glance (most likely 13th) may increase activity to give a spell of Unsettled (Kp 3) conditions with a slight chance of isolated Active (Kp 4) intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/2240	Nil	Filament	SE	530 km/s	Most likely to miss	Any arrival is most likely day 2, but weak impact

Figure 2: MOSWOC Enlil

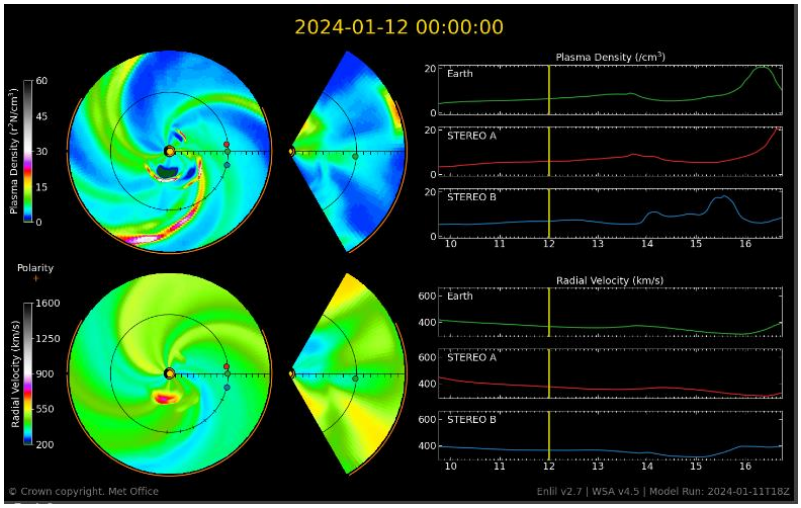
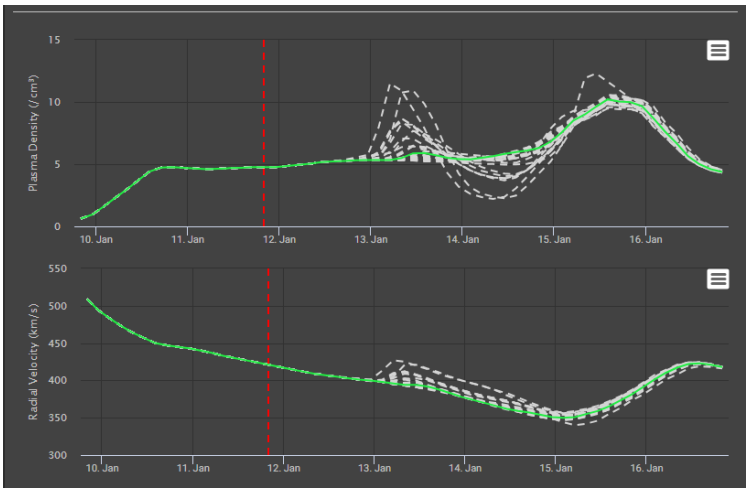


Figure 3: MOSWOC Enlil ensembles with a few members indicating a possible weak glancing impact.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.



Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate with three M-class flares. The largest an M1.5 at 11/2328 UTC from AR3539. Further isolated M-class flares are likely, with AR3539 the probable source, with a slight chance of an X-class flare. The probabilities of significant flares decreases through the period, reflecting AR3539 rotating off behind the west limb later in the period. However, new or returning regions are likely to rotate onto the disc within the next few days. Therefore probabilities may increase again.

There are currently seven numbered regions on the disc, with previous AR3538 having rotated behind the western limb. The four un-numbered groups are all small, weak and magnetically simple. AR3539 and AR3540 have recently decreased slightly in spot number and area. AR3541 has been re-classified as Eai/beta, but is hard to analyse as the region's spots are entwined with AR3540 which is just to the north. AR3544 has increased with rudimentary penumbra developing and is now classified as Dso/beta. The remaining regions are either stable or decaying, and are all magnetically simple.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	55	55	50	40
Very Active	R3 to R5 X Class	No	5	5	5	1

Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is now at background levels. Any further notable flares will bring a risk of proton flux rising, with this risk slightly increased due to the

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

multiple spots in the western hemisphere. This brings a slight chance of reaching the S1 Minor Radiation Storm threshold.
Please note: GOES-18 is currently being used as the primary proton instrument, with GOES-16 data currently viewed as unreliable due to a fault reported by NOAA.

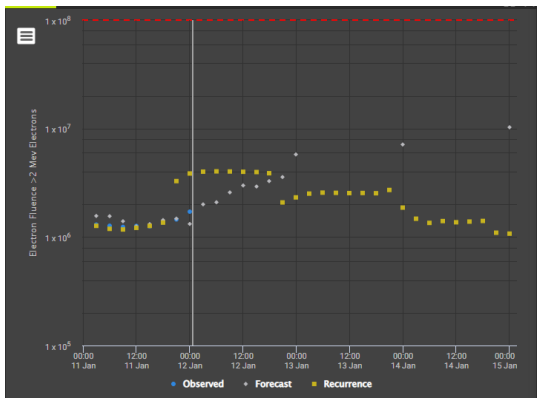
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as measured by GOES-16 at GEO is currently at background, and in the absence of any significant enhancement is expected to persist at this level. The associated 24 hour fluence is expected to remain below the Active threshold. REFM output also keeps the fluence below the Active threshold, despite a gradually increasing trend, and therefore is currently viewed as providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.